REPORT

ON

AFFECTED SALMON IN THE MIRAMICHI RIVER NEW BRUNSWICK

By A. G. HUNTSMAN, B.A., M.B., F.R.S.C., etc.,
Curator of the Biological Station, St. Andrew's, New Brunswick.

OTTAWA
J. DE LABROQUERIE TACHÉ
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1918

23365—1II

IX

REPORT ON AFFECTED SALMON IN THE MIRAMICHI RIVER, NEW BRUNSWICK.

(By A. G. Huntsman, B.A., M.B., F.R.S.C., etc., Curator of the Biological Station, St. Andrew's, New Brunswick.)

In the early part of October, 1915, Mr. G. J. Desbarats, the Deputy Minister of the Naval Service, requested that the Biological Board arrange an investigation of a disease which had broken out among the salmon in the Northwest Miramichi river. I was instructed to proceed to the Miramichi hatchery, South Esk, New Brunswick, examine the conditions there, investigate the possibility of organisms other than bacteria being responsible for the disease, and arrange for the shipment of material for bacteriological examination to Principal F. C. Harrison, of Macdonald College, Ste. Anne de Bellevue, Que.

The hatchery was visited on October 11 and 12. It is located near the mouth of a small stream which empties into the Northwest branch of the Miramichi river, a few miles from Newcastle. Mr. Donald Morrison, the local inspector of fisheries, and Mr. Wm. Sheasgreen, the officer in charge of the hatchery, gave every assistance.

Down the stream from the hatchery is a pond for retaining the salmon previous to the stripping at spawning time. It consists of a portion of the stream enclosed by boards, with spaces between for the circulation of the water. The water is changed regularly by the action of the tide and by the current of the stream. The level of the water in the pond is prevented from falling too low by a dam across the stream below the pond.

A large proportion of the fish in the pond had been officially reported to be visibly affected, and I found white patches of fungus with extensive ulcerations in the centre of many of the patches in the worst cases. The head, the back, and the tail were the parts that in most instances showed evidence of the disease. In the earlier stages the affected parts were seen to be covered with a greyish thin film of fungus, which was easily rubbed off. If the fish were removed from the water these greyish patches could scarcely be seen. The fish that were in the worst condition were sluggish, came inshore into the shallow water, or floated near the surface with the fins exposed. Frequently the caudal fin was partly out of the water and the head very low, the fish floating at an angle approaching the vertical.

Mr. Sheasgreen gave the following information on October 12:—

> "During the latter part of September small marks, chiefly on the head, were noticed on a large proportion of the fish in the pond. A few marked fish (those with definite wounds) had been received from the fishermen. It has been the custom whenever an opportunity presented to take these marked fish from the pond and bury them. The records show that twenty-two fish were taken out from the 18th to the 21st of September, three on the 25th, and five on the 28th. On the outbreak of the disease (the last of September) at first only dead fish were removed, but later badly infected living ones as well. Beginning with September 30, fish were received every day, never less than seven, and once as many as thirty-eight. The dead fish were all well covered with the fungus. On October 6 we began to reject some of the fish brought in by the fishermen, who by this time were noticing the fungus on some of the fish that they were catching. Of the fish brought in there were no large number badly marked previous

to October 6. They all showed, if any, only slight marks, and no evident fungus. From that date on, from 15 to 30 per cent (2 to 4 out of every dozen) of the fish taken each day from three traps near the hatchery, of which records were kept, showed signs of the disease, and were rejected. The fish from a trap 2½ miles up the river showed twenty-six affected out of a total of fifty-two on October 6, twenty-two out of 40 on October 8, and three out of thirteen on October 11, apparently showing a steady improvement as if the infected fish had passed up the river. Up to nearly the 8th of October the salmon in the pond did not seem to be as active (jump as much) as in previous years, but since that date there has been a marked improvement.

"Last year (1914) there were 2,636 salmon in the pond. This year the pond has been enlarged and is from one-quarter to one-third larger than last year. The number of fish that had been placed in the pond previous to September 30 was 2,308.

"This disease has not been noticed in the salmon in any year previous to this, although salmon in the Gaspe region are reported to have had fungus disease last year."

From a comparison of the numbers of the fish and the sizes of the pond it is evident that there has been far less crowding of the fish this year than last. As to temperature, the Monthly Weather Reviews of the Meteorological Service show that at Chatham, 20 miles from the hatchery at the mouth of the Miramichi river, the mean monthly temperatures for the months of August and September, 1915, are only slightly (·6° and ·2°) above the averages for those months for the past forty years. And for the month of September both the mean temperature and the maximum temperature are lower than for the same month in 1914.

The temperature records for the water at the hatchery are incomplete. Temperatures were observed in the hatchery from August 30 to September 20. The records show a range from 50° to 68°F., with an average temperature of about 58°. Temperatures have been observed in the retaining pond from October 6 to 20, and show a range from 46° to 52°, the temperature remaining comparatively uniform during that period. Temperatures observed in the hatchery from October 14 to 20 show that on bright days the temperature in the pond is two to three degrees higher than in the hatchery, and on cloudy days about the same as in the hatchery. Judging from this, the temperature in the pond has at no time since fish were put in (September 11) been higher than 65°F. Temperature does not appear to have been a special causative factor in 1915. The gradual lowering of the temperature has doubtless helped to stop the spread of the disease, Mr. Sheasgreen stating that on October 20 no new diseased fish were appearing.

As to the place of origin of the disease, the presence of diseased fish among those caught in the traps over a considerable period of time indicates that the disease was present for some distance up and down the Northwest Miramichi river. Diseased fish were not noticed among those taken from the traps until one week after the disease had been observed in the pond. Mr. Sheasgreen states that he and his assistants buried all the fish removed from the pond. This obviates the possibility of fish from the pond having carried the infection to the fish in the river, although not the possibility of the pond having served as a source for the distribution of the infection up and down the river.

The avenue of infection appears to have been chiefly through abrasions of the skin. The principal parts seen to be affected in the early stages of the disease were: the tip of the snout, the margins of the jaws, the top of the head, and the middle line of the back, and the margins of the fins. These are the parts most liable to injury in the traps or in the cars used for transporting the salmon to the retaining pond. An examination of the fish caught in the traps and brought to the retaining pond on

October 12, all with no visible disease, showed that the great majority had some abrasions, the commonest being on the tip of the snout, the top of the head, and the margins of the fins (particularly the caudal). There were also net marks around the middle of the head and the marks of fish lice (removal of scales) along the middle line of the back in a number of cases. These marks explain the usual distribution of the fungus, the other parts of the body—for example, the sides—being attacked only in the later stages.

The vigour of the fish declines with the spread of the fungus. Fish with well-developed but localized patches of fungus on the head or elsewhere, or with wounds raw or bleeding, appeared to be nearly as vigourous as healthy fish. But if the fungus were present over much of the surface they were sluggish, came close inshore or floated near the surface with the fins, particularly the caudal, sticking out of the water. In the last stages they dropped to the bottom of the water on their sides.

The only data with reference to the rate of spread of the disease have to do with a fish put in clean on October 4th and removed on the 12th in a sluggish condition, with the fungus covering most of the surface, but so slightly developed that it was not easily seen after the fish had been removed from the water.

The salmon-louse [*Lepeophtheirus salmonis* (Kröyer), see Wilson, 1905, p. 649] was found on a fairly large proportion of the fish taken from the traps. It occurred chiefly along the middle of the back between the fins. It appears to be responsible for the removal fo the scales and doubtless determines the location of the disease in this region.

The fungus proved to be *Saprolegnia*, several species of which are commonly found growing on dead organic matter in fresh water. Prof. J. H. Faull of the University of Toronto, to whom material was submitted, informs me that it belongs to the *ferax* group of *Saprolegnia*, but since no oospores could be seen (they are rarely found) exact identification was impossible. Several species of the *ferax* group occur on dead or diseased fishes (Hofer, 1906, p. 106.) The growth and extension of the *Saprolegnia* proceeds *pari passu* with the disease and may be taken as an evidence of the extent of the disease. Whether its relation to the disease is to any extent a causal one or whether it is merely an accompaniment, may well be disputed.

An examination of the internal organs of the diseased salmon revealed no distinct lesions. A microscopic study of the body fluids and of sections of the organs likewise revealed nothing. We may conclude that the disease is confined strictly to the skin and subjacent parts.

The bacteriological examination of the diseased fish was in the hands of Principal Harrison. However, having some material, I handed over to Dr. H. K. Detweiler of the Pathological Department, University of Toronto, portions of the skin from fish in various stages of the disease. He very kindly had sections made and stained with thionin blue in order to demonstrate, if possible, the presence of the *Bacillus salmonis pestis*, which was found by J. Hume Patterson (1903) in cases of the salmon disease occuring in Great Britain. He informs me that no positive results have been obtained. Negative results in such a case prove nothing.

The gross characters of this disease appear to be identical with those of the well known salmon disease that appeared in the form of an epidemic among the salmon in certain rivers in the north of England and Scotland in 1877. It spread in the course of a few years to the neighbouring rivers up and down the coast and has continued in an endemic state in the waters of Great Britain ever since. No means of successfully combatting it has as yet been found.

The *Saprolegnia ferax* was for many years considered to be the cause of the disease (Stirling, 1878 and 1879, and Walpole and Huxley, 1882). In 1903, however, Patterson published the results of investigations which went to show that *Saprolegnia* was not

responsible for the disease, but a *Bacillus (B. salmonis pestis)*. The *Bacillus* alone brought about the death of fish, but not the *Saprolegnia* alone. The latter was able to grow in tissues already invaded by the *Bacillus*. The *Bacillus* grew in sea water, but the *Saprolegnia* did not. Salmon affected by the disease while in salt water would therefore not show any fungus until after arriving in fresh water. Patterson states that the cold season is more favourable for the growth of the *Bacillus* and Malloch (1910, p. 117) states that the colder the weather the worse the disease becomes. But Patterson's experiments merely show that the *Bacillus* grows better at 0° C. (32° F.) than at 37° C. (98.6° F.), whereas at room temperature (60° F. ?) the growth was very much more rapid than at 0° C.

In the case of the disease in the Miramichi river, Mr. Sheasgreen has stated that the condition of the fish in the pond improved rapidly during the latter half of October and at the same time the number of diseased fish taken in the traps decreased. The lower temperature *may* have been responsible for this, either by improving the condition of the fish or by decreasing the rate of spread of the infection.

For eradicating the disease our only hope, and that a slender one, is to systematically remove all dead and diseased fish as soon as discovered. Patterson recommends that they be burned and *not buried*, since the organisms survive in the dead fish and may be carried again into the streams. Unless due to some undiscovered temporary factor, the disease is practically certain to appear again.

Whatever organism may be most responsible for the disease, the latter being an affection of the skin, will be influenced by other organisms as well, and there will also be a number of contributing factors, the chief of which will be those that lower the general vitality of the fish. In the case of the salmon retained for spawning purposes, an effort should be made in the future to improve the conditions in the ponds, particularly with regard to renewal of the water and the attainment of the most suitable temperature, so that the fish will be affected as little as possible. If the disease reappears, experiments should be instituted to determine the conditions best adapted to prevent its spreading.

The use of the fish for spawning purposes raises the question of the possible effect of the disease on the eggs or on the next generation. The Deputy Minister informs me under date of April 6, 1916, that in three hatcheries, supplied from the Miramichi retaining pond, the loss had already reached a figure of from 42 per cent to 61 per cent of the original number of eggs. It seems probable that many infected fish had recovered, as maintained by Mr. Sheasgreen, and that these gave eggs of greatly lowered vitality. The fish stripped were all in good condition, and precautions were taken to prevent any infection reaching the eggs from the exterior of the fish or from the pond.

What would be the result if some of the infection did reach the eggs? The *Saprolegnia* is known to attack fish eggs, but it is at least probable that this occurs only when the eggs are of low vitality. Also *Saprolegnia* spores are so widely distributed as to be present in the water in the hatching troughs in any case, although those from the fish may belong to a more virulent strain.

It is improbable that the bacteria, which may have a causal relation to the disease in the salmon, will attack the salmon eggs. Plehn (1911) found that *Bacterium salmonicida*, which produces furunculosis in the brown trout (*Salmo fario*) attacked neither the eggs, the alevins, nor the fry of the trout, but did attack the yearlings. It is therefore quite unlikely that the disease can be transmitted through the fry and by that means be carried to the streams in which fry from Miramichi eggs may be planted. It is possible, however, that it might be carried in the water used for shipping the eggs or fry.

It is very desirable that during a future season other rivers should be investigated. It has been claimed that in the rivers of Great Britain the salmon disease was present in a sporadic form previous to the outbreak in 1877.

LITERATURE.

Hofer, B. Handbuch der Fischkrankheiten. Stuttgart. 1906.

Malloch, P. D. Life-History and Habits of the Salmon, etc. London. 1910.

Patterson, J. H. The Cause of Salmon Disease. Pub'n., Fishery Board for Scotland. 1903.

Plehn, M. Die Furunkulose der Salmoniden. Centralbl. f. Bakt., etc., I Abt., Originale, Bd. 60, Ht. 7, p. 609, 1911.

Stirling, A. B. Notes on the Fungus Disease affecting Salmon. Proc. Roy. Soc. Edin., vol. IX, p. 726. 1878.

Additional Observations on the Fungus Disease, etc. Proc. Roy. Soc. Edin., vol. X, p. 232. 1879.

Walpole and Huxley. On Saprolegnia in Relation to the Salmon Disease. Quart. Journ. Micr. Sc., vol. XXII, new series, p. 311. 1882.

Wilson, C. B. North American Parasitic Copepods belonging to the Family Caligidae. Part I. The Caliginae. Proc. U. S. Nat. Museum, vol. XXVIII, p. 479. 1905.